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(54) **Method for milking an animal and device for this purpose**

(57) A method of milking an animal by means of a milking device (1) provided with at least one teat cup (2) having a pulsation space and a teat space. The teat space is connected to a vacuum source via (10) a milk tube (5a,5b), the teat space and the milk tube forming a milking space, which method comprises successively a connection step, a milk-drawing step and a disconnection step. During the milk-drawing step a pulsating pulsation vacuum is present in the pulsation space and a milking vacuum is present in the teat space. In the disconnection step the milking vacuum is lowered after which the teat cup is drawn away from the animal by the device, the vacuum level being measured in a part of the milking space. The teat cup is drawn away after the vacuum level has come below a threshold value.

A milking device (1) provided with a robot (14) for

automatically connecting at least one teat cup (2) to a teat of an animal, which teat cup (2) comprises a teat space for containing a teat and a pulsation space for applying a milking motion by means of a pulsating pulsation vacuum. The teat space is connected via a milk tube (5a,5b) to a vacuum source (10) for generating a milking vacuum. The teat space and the milk tube form the milking space, with a drawing-away device (3) for drawing the teat cup (2) away from the animal, with a vacuum-lowering device for lowering the milking vacuum in the teat space, with a computer (11) for activating the drawing-away device (3) after the milking vacuum has been lowered, the milking space comprising a sensor (16) for measuring the milking vacuum and emitting to the computer (11) a milking vacuum signal. The drawing-away device (3) is capable of being activated when the vacuum level comes below a threshold value.

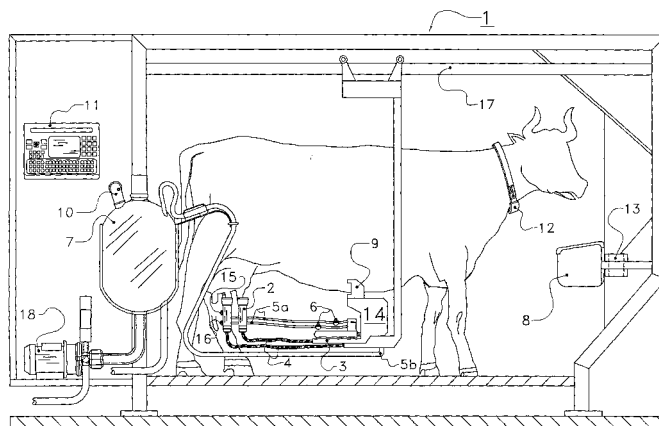


FIG. 1

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Description

[0001] The invention relates to a method of milking an animal according to the preamble of claim 1.

[0002] Such a method is known. Such a method of milking has the disadvantage of being unpleasant to some animals. When the milk-drawing phase has been completed, the milking vacuum is lowered in the disconnection-preparing step by air flowing into the teat cup. Even before the milking vacuum has completely been removed, a drawing force is exerted on the teat cup. The vacuum that is still present in the teat cup also exerts a drawing force on the teat of the animal via the teat cup. In some cases the drawing force on the teat may be very high, which is experienced as unpleasant by the animal.

[0003] The invention aims at providing an animal-friendly method of milking animals. This is achieved by the above-mentioned method which is characterized in that the disconnection step follows as soon as the vacuum level in the milking space has come below a threshold value in the disconnection-preparing step. By the vacuum level coming below the threshold value is meant that the absolute (air)pressure in the teat cup rises to above the mentioned threshold value.

[0004] The vacuum level is preferably measured in a part of the milking space. On the basis of the measured value it is then possible to determine whether the vacuum level has come below the threshold value. Such a method can easily be executed in an electronic manner with the aid of a vacuum sensor. This has the advantage that the threshold value is simply adaptable.

[0005] In a further favourable embodiment of the method, the threshold value depends on the vacuum level at the beginning of the disconnection-preparing step. In this manner, after a fixed vacuum lowering, the disconnection step can start.

[0006] In again a further favourable embodiment of the method, the disconnection step follows after the vacuum level has come below the threshold value longer than a predetermined period of time. Said period of time is preferably adjustable per animal and/or per teat, so that the lowering speed of the vacuum level can be taken into account. With a thin teat said speed will be higher, because in this case more exterior air will be able to leak into the teat space. Such a teat requires a shorter time in order to prevent the teat cup from falling from the teat by its own weight.

[0007] The threshold value is preferably adjustable per animal or per group of animals. This makes it possible to set the threshold value at a lower vacuum level for sensitive animals, so that the teat cup is drawn from the teat with less force.

[0008] According to another embodiment of the method, the lowering speed is adjustable per animal. This makes it possible to lower the vacuum more gradually for sensitive animals.

[0009] According to an embodiment, the milking vacuum is lowered by admitting inlet air into a part of the

milking space. This has the advantage that the vacuum can be lowered in a controlled manner.

[0010] By admitting inlet air via a separate air line the amount and the sort of air to be admitted can be controlled properly. This also provides the freedom of selecting the optimum air inlet place in the milking space.

[0011] In a favourable embodiment, the inlet air is conditioned prior to being admitted. This prevents inter alia contamination of the milking space by dirt present in the inlet air. Conditioned air may also feel more pleasant to the animal.

[0012] According to an embodiment, the part of the milking space is the teat space. Because of the fact that only the vacuum in the immediate vicinity of the teat is relevant to the drawing force exerted by the teat cup, it is advantageous to measure the vacuum level in the teat space.

[0013] Because of the fact that in the milk tube there are more possibilities of disposing a sensor, according to again another embodiment the part of the milking space is the milk tube.

[0014] According to a further embodiment of the method, the milking vacuum is lowered by shutting off the milk tube from the vacuum source.

[0015] In a particular embodiment, the drawing away takes place while exerting an increasing drawing force in order not to frighten the animal.

The invention further relates to a milking device as claimed in claim 18. Favourable embodiments are mentioned in the relevant sub-claims.

[0016] Figure 1 shows a milking device 1 provided with a robot 14 for automatically connecting at least one teat cup 2 to a teat of an animal, which teat cup 2 comprises a teat space for containing a teat and a pulsation space for applying a milking motion by means of a pulsating pulsation vacuum, the teat space being connected via a milk tube 5a, 5b to a vacuum source 10 for generating a milking vacuum, the teat space and the milk tube 5a, 5b forming the milking space, with a drawing-away device 3 for drawing away the teat cup 2 from the animal, with a vacuum-lowering device for lowering the milking vacuum in the teat space, with a computer 11 for activating the drawing-away device 3 after the milking vacuum has been lowered, the milking space comprising a vacuum sensor 16 for measuring the vacuum level and emitting to the computer 11 a vacuum signal that is representative of the vacuum level, characterized in that the drawing-away device 3 is capable of being activated by the computer 11 when the vacuum level in the milking space comes below a threshold value.

[0017] The milking device 1 comprises an animal area to which the animal to be milked (here depicted as a cow) has access by means of a non-shown entrance door. There is provided a robot 14 for automatically connecting teat cups 2 to the teats of the animal. To this end, a teat position meter 9 for determining the position of a teat is fitted to the robot 14. Said meter is depicted as a scanning laser, but may comprise any type of po-

sition meter. In order to be able to follow movements of the cow in longitudinal direction, the robot 14 is suspended from a rail 17. The animal identification device 13 comprises a transponder 12 fitted to the cow and a transmitter/receiver that is fixedly attached to the milking device 1. The transponder 12 is designed to transmit a unique signal by means of which an individual cow can be recognized. Two of the four teat cups 2 are depicted, said two teat cups being connected to two of the four teats of the cow. The teats are located in the teat spaces of the relevant teat cups 2. Each teat space is connected to the milk glass 7 via a milk tube 5a, 5b. Transport of milk from the teat cup 2 to the milk glass 7 takes place owing to the fact that there is a milking vacuum in said milk glass 7. Said milk glass 7 serves for temporary storage of milk and for separating the air/milk mixture. The vacuum is generated by a vacuum pump fitted to the vacuum source 10. There is provided a milk pump 18 for conveying by pumping the drawn milk for further milk processing. For the purpose of supplying feed in the milking device 1 there is further disposed a manger 8. The components of the milking device 1 are controlled by the computer 11.

[0018] To each teat cup 2 there is attached a teat meter 15 for determining the length of the teat. Said teat meter is designed as a series of contactless proximity sensors. The teat position meter 9 scans the teats in the connection step. The scan data may be used by the computer 11 for determining a teat parameter, such as the length or the diameter of the teat. Besides, in the teat space of each teat cup 2 there is disposed a vacuum sensor 16 for detecting the vacuum level in the teat space. The vacuum sensor 16 is disposed in such a way that it cannot come into contact with a teat.

[0019] Air can be admitted into the teat space under light overpressure via a non-shown air line. In this case the air line is connected to a non-depicted conditioning device in the form of a filter for conditioning the inlet air. The amount of air to be admitted is controllable by the computer 11 by means of a valve.

[0020] The milking device 1 comprises a non-depicted counter for registering the time elapsed since the vacuum level has come below the threshold value, the drawing-away device 3 being capable of being activated by the counter.

[0021] The operation of the milking device 1 is as follows. A cow reports at the milking device 1 and is identified. The animal recognition signal is passed to the computer 11 and the latter decides on the basis of known criteria whether the cow should be milked. The entrance door is opened and the connection step is performed. In a known manner said step comprises successively cleaning of the teats, determination of the teat positions, and connection of the teat cups 2 by the robot 14 on the basis of the teat positions. Then the milk-drawing step, the milking proper, is performed. To this end, a pulsating vacuum is applied to the pulsation space, which pulsating vacuum exerts a squeezing motion on

the teat. The amount of air that is required for each pulsation motion is an indication of the shape of the teat. By means of a volume meter that is present in the pulse line said air is measured and the measurement result is passed to the computer 11. In case of a thin teat there is required relatively much pulsation air for this purpose. By means of a vacuum sensor 16 in the teat space the milking vacuum is also measured. Said milking vacuum is compared with the measured vacuum of the vacuum source 10. A great difference is an indication of much leaking air along the teat.

[0022] In general there may be distinguished different phases in drawing milk from an animal. There is a start-up phase with increasing milk flow, a main milking phase in which the milk flow is more or less constant, and a final phase with decreasing milk flow when the udder is almost empty. On the basis of the data from the (non-shown) milk flow meter the computer 11 can determine in which phase the milk-drawing is. If this is the main milking phase, the measured pulsation amount and the measured milking vacuum are considered as relevant.

[0023] The obtained measurement data are stored in the memory of the computer 11 and are used for future milkings.

[0024] When the milk flow has fallen below a particular value, the disconnection-preparing step begins. The milking vacuum is stopped by shutting the valve 6 in the milk tube 5a.

[0025] The vacuum sensor 16 measures the vacuum in the teat space. When the vacuum has fallen below a threshold value, the disconnection step begins. The threshold value may be manually inputted beforehand into the memory of the computer 11 for a particular animal or group of animals, for example animals of a particular age. The threshold value may also be set by the computer 11 itself on the basis of other data from the memory. For example, when a (beginning) mastitis infection has been diagnosed in an udder quarter, the computer 11 decides to set the threshold value at a lower vacuum level (higher pressure). In that case also the speed at which the vacuum is lowered is set at a lower level by the computer 11 with the aid of the vacuum-lowering device. The valve in the inlet line constitutes part of said vacuum-lowering device. By not entirely opening said valve and by closing the valve 6 in the milk tube 5a only slowly, it is achieved that the milking vacuum is lowered only very slowly. Lowering the vacuum more slowly also takes place if the animal to be milked is very sensitive.

[0026] At the moment when the milking vacuum comes below the threshold value, the counter is activated. When a fixed time, for example 2 s, has elapsed, the counter activates the drawing-away device 3 to disconnect the teat cups 2 and the disconnection step begins to disconnect the teat cups 2 from the teats. In the figure shown, this takes place actively by pulling the teat cups 2 towards the robot arm by means of the cords 4. For this purpose, each cord 4 is attached to a separately

operable (non-shown) drawing-back cylinder. Because of the fact that each udder quarter will be empty at a different point of time, each teat cup 2 can be disconnected independently of another. The force and speed at which a teat cup 2 is drawn away may be set differently per teat cup 2.

[0027] In a non-shown embodiment, the disconnection step is carried out by the cow herself. In this case the (non-shown) exit door of the milking device 1 is opened by the computer 11 after the waiting time has elapsed, so that the cow can leave the milking device 1. When leaving the milking device 1 the cow loosens herself the teat cups 2 that are still connected to her teats. This may take place, if desired, in combination with the active withdrawal of the teat cups 2 by the robot 14. If the cow leaves the milking device 1 insufficiently quickly, a (non-shown) driving-out device may still be activated, if desired.

Claims

1. A method of milking an animal by means of a milking device (1) provided with at least one teat cup (2) having a pulsation space and a teat space, which teat space is connected to a vacuum source (10) via a milk tube (5a, 5b), the teat space and the milk tube (5a, 5b) forming a milking space, which method comprises successively a connection step, a milk-drawing step, a disconnection-preparing step and a disconnection step, a pulsating pulsation vacuum being present in the pulsation space and a milking vacuum being present in the teat space during the milk-drawing step, the milking vacuum being lowered in the disconnection-preparing step, **characterized in that** the disconnection step follows as soon as the vacuum level in the milking space has come below a threshold value in the disconnection-preparing step.
2. A method as claimed in claim 1, **characterized in that** the vacuum level is measured in a part of the milking space.
3. A method as claimed in claim 1 or 2, **characterized in that** the threshold value depends on the vacuum level at the beginning of the disconnection-preparing step.
4. A method as claimed in any one of the preceding claims, **characterized in that** the disconnection step follows after the vacuum level has come below the threshold value longer than a predetermined time.
5. A method as claimed in any one of the preceding claims, **characterized in that** the disconnection step comprises the drawing-away of the at least one

teat cup (2).

6. A method as claimed in any one of the preceding claims, **characterized in that** the disconnection step is performed with the aid of a robot (14).
7. A method as claimed in any one of the preceding claims, **characterized in that** in the disconnection step the animal is enabled to carry out at least partially itself the disconnection step by making itself a movement.
8. A method as claimed in any one of the preceding claims, **characterized in that** the threshold value is adjustable per animal or per group of animals.
9. A method as claimed in claim 8, **characterized in that** the identity of the animal is determined automatically.
10. A method as claimed in claim 8 or 9, **characterized in that** the speed at which the vacuum level is lowered is adjustable per animal or per group of animals.
11. A method as claimed in any one of the preceding claims, **characterized in that** the vacuum level is lowered by admitting inlet air into a part of the milking space.
12. A method as claimed in claim 11, **characterized in that** the inlet air is admitted via a separate air line.
13. A method as claimed in claim 12, **characterized in that** the inlet air is conditioned prior to being admitted.
14. A method as claimed in any one of the preceding claims, **characterized in that** the part of the milking space is the teat space.
15. A method as claimed in any one of the preceding claims, **characterized in that** the part of the milking space is the milk tube (5a, 5b).
16. A method as claimed in any one of the preceding claims, **characterized in that** the vacuum level is lowered by shutting off the milk tube (5a, 5b) and/or the teat space from the vacuum source (10).
17. A method as claimed in any one of the preceding claims, **characterized in that** the drawing away takes place while exerting an increasing drawing force.
18. A milking device (1) provided with a robot (14) for automatically connecting at least one teat cup (2) to a teat of an animal, which teat cup (2) comprises

a teat space for containing a teat and a pulsation space for applying a milking motion by means of a pulsating pulsation vacuum, the teat space being connected via a milk tube (5a, 5b) to a vacuum source (10) for generating a milking vacuum, the teat space and the milk tube (5a, 5b) forming the milking space, with a drawing-away device (3) for drawing away the teat cup (2) from the animal, with a vacuum-lowering device for lowering the milking vacuum in the teat space, with a computer (11) for activating the drawing-away device (3) after the milking vacuum has been lowered, the milking space comprising a vacuum sensor (16) for measuring the vacuum level and emitting to the computer (11) a vacuum signal that is representative of the vacuum level, **characterized in that** the drawing-away device (3) is capable of being activated by the computer (11) when the vacuum level in the milking space comes below a threshold value.

19. A milking device as claimed in claim 18, **characterized in that** the milking device (1) comprises a counter for registering the time elapsed since the vacuum level has come below the threshold value, and **in that** the drawing-away device (3) is capable of being activated by the counter.
20. A milking device as claimed in claim 18 or 19, **characterized in that** the milking device (1) comprises an automatic animal recognition device (13) for emitting an animal recognition signal, and **in that** the threshold value is adjustable on the basis of the animal recognition signal.
21. A milking device as claimed in any one of claims 18 to 20, **characterized in that** the vacuum-lowering device (3) is suitable for controlling the speed at which the milking vacuum is lowered, and **in that** the speed is capable of being controlled by the animal recognition signal.
22. A milking device as claimed in any one of claims 18 to 20, **characterized in that** there are provided means for admitting inlet air into a part of the milking space.
23. A milking device as claimed in claim 22, **characterized in that** the milking device comprises a separate air line that debouches into the milking space.
24. A milking device as claimed in claim 23, **characterized in that** the air line is connectable to a conditioning device for conditioning the inlet air.
25. A milking device as claimed in any one of claims 22 to 24, **characterized in that** the part of the milking space is the teat space.

26. A milking device as claimed in any one of claims 22 to 25, **characterized in that** the part of the milking space is the milk tube (5a, 5b).

27. A milking device as claimed in any one of claims 22 to 26, **characterized in that** the milking space comprises a valve (6) for shutting off the connection with the vacuum source (10).
28. A milking device as claimed in any one of claims 18 to 27, **characterized in that** the drawing-away device (3) comprises means for drawing away the teat cup while exerting an increasing drawing force.

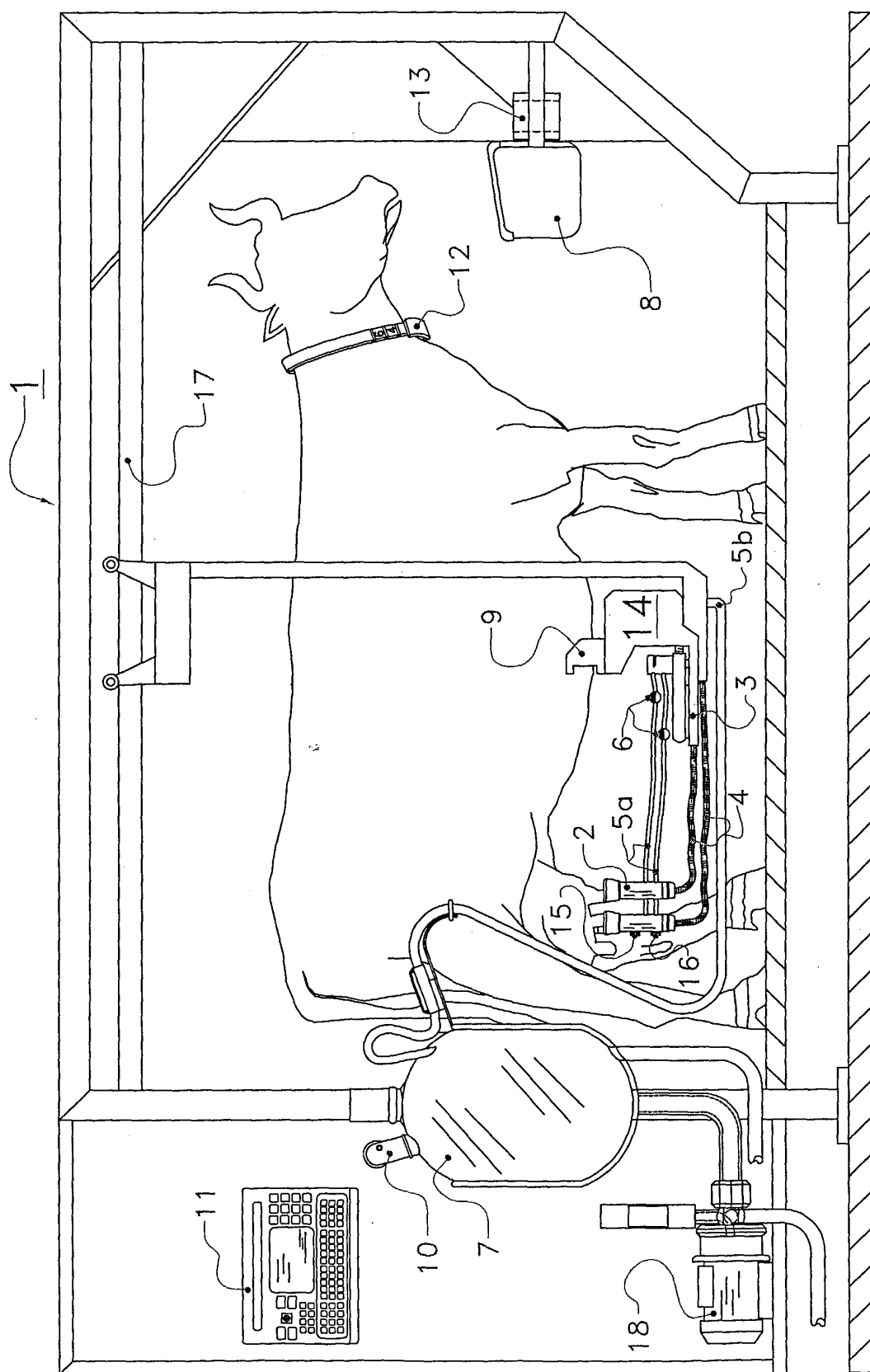


FIG. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 04 07 7320

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	WO 03/055296 A (INNINGS LARS ;DELAVAL HOLDING AB (SE)) 10 July 2003 (2003-07-10)	1-3, 5-10, 14-18, 20,21, 25-28	A01J5/017 A01J5/007 A01J7/00
Y	* page 3 - page 9; claims 1-7; figure 3 *	4,11-13, 19,22-24	
Y	----- EP 0 511 722 A (LELY NV C VAN DER) 4 November 1992 (1992-11-04) * column 4, line 54 - column 5, line 38; figures 2-4 *	11-13, 22-24	
Y	----- US 4 306 590 A (BOUDREAU ARCHIE E) 22 December 1981 (1981-12-22) * column 16, line 5 - line 28 *	4,19	
A	----- US 3 690 300 A (TONELLI GUIDO ANTONIO) 12 September 1972 (1972-09-12) * column 1 - column 3 *	1,18	
A	----- US 5 881 669 A (BEIJE MARINUS ET AL) 16 March 1999 (1999-03-16) * column 3 - column 4 *	1,18	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) A01J
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 16 November 2004	Examiner Moeremans, B
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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16-11-2004

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 03055296	A	10-07-2003	SE 521080 C2	30-09-2003
			EP 1465477 A1	13-10-2004
			SE 0104370 A	22-06-2003
			WO 03055296 A1	10-07-2003

EP 0511722	A	04-11-1992	NL 8900479 A	17-09-1990
			EP 0516246 A2	02-12-1992
			EP 0511722 A2	04-11-1992
			EP 0511723 A2	04-11-1992
			EP 0510779 A2	28-10-1992
			NL 9001689 A	16-09-1991
			AT 106179 T	15-06-1994
			AT 116799 T	15-01-1995
			AT 117504 T	15-02-1995
			AT 116519 T	15-01-1995
			AT 128321 T	15-10-1995
			DE 69009235 D1	07-07-1994
			DE 69009235 T2	26-01-1995
			DE 69015828 D1	16-02-1995
			DE 69015828 T2	10-08-1995
			DE 69016045 D1	23-02-1995
			DE 69016045 T2	20-07-1995
			DE 69016461 D1	09-03-1995
			DE 69016461 T2	20-07-1995
			DE 69022746 D1	02-11-1995
			DE 69022746 T2	25-04-1996
			DK 385539 T3	26-09-1994
			DK 516246 T3	18-04-1995
			DK 511722 T3	27-03-1995
			DK 510779 T3	04-12-1995
			EP 0385539 A2	05-09-1990
			EP 0584890 A2	02-03-1994
			NL 9900001 A ,B	01-06-1999
			NL 9900002 A ,B,	01-06-1999
			NL 9900003 A ,B,	01-06-1999
			US 5080040 A	14-01-1992
			US 5195456 A	23-03-1993
			US 5272997 A	28-12-1993
			US 5275124 A	04-01-1994

US 4306590	A	22-12-1981	US 4198999 A	22-04-1980
			US 4295490 A	20-10-1981

US 3690300	A	12-09-1972	SE 340911 B	06-12-1971
			CS 166264 B2	27-02-1976
			DE 2052532 A1	03-06-1971

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 07 7320

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16-11-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3690300 A		FR 2069169 A5	03-09-1971
		GB 1265636 A	01-03-1972

US 5881669 A	16-03-1999	NL 9401937 A	01-12-1995
		AU 694480 B2	23-07-1998
		AU 1762595 A	02-11-1995
		AU 5352299 A	09-12-1999
		AU 713282 B2	25-11-1999
		AU 7417598 A	03-09-1998
		DE 69527168 D1	01-08-2002
		DE 69527168 T2	06-02-2003
		DK 679331 T3	14-10-2002
		EP 1186229 A2	13-03-2002
		EP 0679331 A2	02-11-1995
		US 5651329 A	29-07-1997

EPO FORM P0459

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